Advanced Discriminating LADAR Technology (ADLT) Program

Advanced missile threats emerging in the 21st century require development of advanced laser radar (ladar) sensing capabilities. The U.S. Army Space and Missile Defense Command is developing ladar seeker technology to augment sensors of the Exoatmospheric Kill Vehicle (ExoKV) through the Advanced Discriminating LADAR Technology (ADLT) Program. Current ExoKV seekers can use three passive sensors (one visible and two infrared [IR]) for acquisition, tracking, limited discrimination, and aimpoint selection in the terminal homing phase. The visible sensor must rely on external illumination (Sun, moon, stars, Earthshine) and the IR sensors use emitted radiation to perform their tasks.

Advanced threats may include reentry vehicles (RV) and identically shaped precision lightweight replica decoys with RV-like motion as well as many Closely-Spaced Objects (CSO) to degrade the discrimination performance of current non-imaging, passive ExoKV seekers. The increased traffic in future threat clusters, jammers, chaff, and radar absorbing materials may degrade the acquisition and discrimination coordination between ground-based radars and passive ExoKV seekers. However, the presence of an ADLT Range-Resolved Doppler Imaging (RRDI) ladar seeker onboard the ExoKV will substantially reduce coordination concerns.

The RRDI ladar does not rely on external illumination or emitted radiation from the target. The RRDI ladar illuminates each target to measure target range, velocity, and angular rates and forms images that resolve the target in the range and cross-range (breadth) dimensions. The RRDI images substantially increase the number of target features measurable by the discrimination function of a ladar-upgraded ExoKV seeker. The precision 4-dimensional (4-D) track of a RRDI ladar seeker improves the quality of the guidance function which reduces the amount of fuel needed to divert to the target. Each upgraded ExoKV passive sensor and the ADLT RRDI ladar shares the same small telescope system. The ADLT Program is developing all of the optic, photonic, electronic, and software components of a compact RRDI ladar seeker for hosting on a future, upgraded ExoKV.

ADLT uses a one-micron, solid state laser transmitter to illuminate targets with coherent radiation. ADLT receiver optics collect and focus back-scattered Doppler-shifted radiation from the target onto a detector array where it is mixed (heterodyned) with a local oscillator signal derived from the transmitting laser.

Heterodyning makes the signal detection process very sensitive to tiny, distant received signals and impervious to clutter noise sources. A modulated waveform is applied to the ladar transmitted signal to permit the received signal to be processed to produce 4-D precision track (range, azimuth, elevation, and Doppler) measurements and RRDI images of each advanced target. These measurements, precisely and quickly (1/100th of a second), locate the target and produce RRDI images that enhance in multiple ways the system discrimination function onboard an ExoKV.

Most RRDI images nominally have more than 10 range bins in the projected range dimension and many 10's of Doppler bins in the cross-range dimension even when targets are hundreds of kilometers from the ladar seeker. These image changes yield features that permit advanced conical penetration aids to be discriminated on the basis of their body-centered motions that differ from that of an RV. Very sensitive Doppler measurement properties of the ladar received signal magnify cross-range measurement resolution by orders of magnitude beyond what is physically feasible by a passive seeker sharing the same aperture. These Doppler measurement properties of the RRDI ladar map the relative velocities of tiny surface areas of RVs and decoys to extract motion feature differences that serve as discriminants.

The RRDI ladar is not affected by radar jammers or chaff and can readily separate and discriminate objects that appear as CSO to the ExoKV passive seeker. Adding an RRDI imaging seeker to an ExoKV improves CSO resolution, improves seeker discrimination quality against advanced replica decoy threats, increases lethality, reduces KV fuel and reduces missile defense system susceptibility to jammers and chaff.

For more information, please contact:

U.S. Army Space and Missile Defense Command
Public Affairs Office
P.O. Box 1500
Huntsville, AL 35807-3801
Phone: 256-955-3887
Fax: 256-955-1214
Email: webmaster@smdc.army.mil
www.smdc.army.mil